Integrating the *JEI* Process into the Classroom

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LESSON 1

Lesson: Implementing a Peer Review Environment

Timeframe: approximately 2-3 class periods

Target audience: Middle school – High school sophomore

- Rigor can be increased for high school by decreasing embedded UDL strategies

Materials: Accountable Talk worksheets, Scientific Method Scenarios worksheets, Classroom Daily Goals slip, Exit Ticket slips

Teacher prep:

Accountable Talk:

Accountable Talk is a structured model of classroom communication that requires students to utilize Claims, Reasoning and Evidence during classroom discourse. It is comprised of classroom conversation norms that fosters an environment of mutual respect and discussions stems/language tools necessary to build productive academic discussion.

These are foundational for Peer Review in the classroom, which prepares students for the constructive criticism/comments once student's manuscripts are reviewed by JEI.

https://ifl.pitt.edu/how-we-work/videos.cshtml

Supplement A: Accountable Talk Talking Stems

Supplement B: Teacher Talking Prompts

Supplement C: Classroom Norm Daily Goal

Supplement D: Accountability Reference Sheet

Supplement E: Exit Ticket

Lesson:

Creating a Collaborative Environment

- *Teacher will affix/tape Accountable Talk Stems (Supplement A) and Accountability Reference sheet (Supplement D) to student desks for student reference (posted Anchor Charts can also be utilized). In addition, teacher will print both the Accountable Talk Stems and Accountability Reference sheet for class activity.*

- Students will be given a brief introduction to the objectives:
  - Create a model of whole-group discussion and scaffolding via Accountable Talk in order to stimulate: higher-order thinking, reflective learning, and discourse in a constructive and respectful manner.

- (*GROUP WORK*) Place students into groups of 3-4 and ask them to brainstorm a list of Classroom Discussion Norms.

- (*WHOLE GROUP DISCUSSION*) Bring the class back for a whole group discussion and list the group ideas. Ask the students to vote on the ideas and create 4-5 student-based classroom discussion norms.

- (*INTERACTIVE LECTURE*) Teacher will add the Classroom Norm Daily Goals (*Supplement C*) to classroom discussion expectations. Once norms are finalized, display a large poster listing them.

- *(EMBEDDED PRACTICE)* Teacher will reference Classroom Norms poster(s) in the beginning of each class until it becomes deeply integrated into classroom culture. Ensure that students feel safe and comfortable speaking in front of their peers prior to beginning lesson.

- (*INTERACTIVE LECTURE*) Teacher will explicitly state the purpose of using conversational stems. Remind students that utilizing constructive language will help them enhance their writing, speaking and listening skills in school, but also in life both professionally and informally. Set the expectation of using the stems as a daily practice. Remind students that a percentage of their grade is directly aligned to their ability to speak and write using the conversation tools.

- (*SCAFFOLDING*) Teacher will scaffold by introducing the Accountable Talk stems first and then introducing the Metacognition stems accordingly once students become comfortable with the format.

- (*GROUP PRACTICE)* Teacher will introduce a debatable Science/STEM topic. Students will practice using the stems in small groups (3-4 students) to debate the topic before having to participate during whole-group discussion. Each group must utilize each of the Accountable Talk Stems. The students will identify their purpose (*Supplement D)* prior to utilizing the Accountable Talk stem. Teacher will have printed copies of Supplement A for students. Each student must use at least one choice from each stem box. They must initial the ones that they use for credit. The teacher will circulate and utilize Teacher Talking prompts (*Supplement B)* to spur conversation when needed.

- (*WHOLE GROUP DISCUSSION*) Teacher will bring class back to whole group and introduce another debatable Science/STEM topic. Students will continue practicing introducing their purpose (Summarize, Verify, Defend, Unpack…etc.) and utilizing Accountable Talk stems. Teacher will continue to utilize the Teacher Talking prompts to spur conversation if needed. Teacher will introduce Metacognition stems in a similar fashion once the students feel comfortable utilizing the Accountable Talk stems.

- (*EXIT TICKET*) Teacher will provide Self-Reflection activity (*Supplement E*) to students. Teacher will monitor class responses and adjust future lessons accordingly to increase student comfort and emotional safety.

SUPPLEMENT A:

ACCOUNTABLE TALK STEMS	**ACCOUNTABLE TALK STEMS**
Clarifications: "Could you please repeat that for me?" "Could you explain a bit more, please? "I'm not sure I understood you when you said …could you say more about that?" "What's your evidence?" "Something that is still not clear is…." "To understand better, I need to know more about…" "I'm guessing this means_____, but I need to..." "I'm confused by….."	**Agreement** "I agree with_____ because…" "I like what _____said because…" "I agree with _____, but on the other hand…" "Based on my evidence, I think…." "I want to add to what_____ said…."
Disagreement "I disagree with _____because…" "I'm not sure I agree with _____because…"	**Summarizing** "The basic idea here is….." "The key information is….." "In summary, this says that…" "First….Next….Then….Finally..." "To expand on what _____said….."
METACOGNITIVE EXTENSION STEMS	**METACOGNITIVE EXTENSION STEMS**
Synthesizing "I'm beginning to think…" "I used to think_____, but now…" "I'm changing my mind about…"	**Visualizing** "I can picture…" "In my mind, I picture…" "I can feel…see….smell….taste….hear….touch…"
Determining Importance "One thing we should notice is…" "It's interesting that…" "What's important here is…"	**Asking Questions** "I have a question about…" "I want to question whether…" "One question we haven't thought about or considered is…." "I still have this question about…"
Making Connections "This relates to…" "I already know that…" "I'm remembering..." "This reminds me of [ANOTHER TEXT] because…" "This is relevant to my life because…"	**Inferring/Predicting** "If _____, then……" "This could mean…" "I infer……" "My guess is……" "I assume….." "I think this represents…."
Reflecting and Relating "A conclusion I'm drawing is…" "So the big idea is…" "This is relevant to my life because…."	**Monitoring for Meaning** "I need to reread the part where….." "I know I'm on the right track because…" "I got confused here because..." "What this means to me is….." "Now I understand why…"
Evaluation "I like/don't like_____ because…" "This could be more effective if…" "The most important message is…"	

SUPPLEMENT B:

TEACHER TALK PROMPTS

Use these prompts when engaged in discussion with students to guide them in taking ownership of their thinking and the conversation.

REVOICING:
"So you're saying/asking/seeking clarification on [restatement of the student's comment/question]. Do I have that right?"

RESTATING:
"[Student name], restate or rephrase what [other student name] said."

PROVIDING EVIDENCE:
"How do you know? or What evidence from the text supports your thinking?"

AGREEING/DISAGREEING:
"Who agrees/disagrees with [student name]? [Call on a student who indicates agreement or disagreement.] Why?"

ELABORATING:
"Can someone add to what [student name] said?"

WAITING:
"Take your time. We'll wait." "Can anyone help out [student name] and then allow them to finish your thought?"

REVISING:
"Who wants to change their thinking after listening to [student name]'s explanation/comment/question? [Call on a student who indicates a desire to change thinking.] How did it change your thinking?"

SUPPLEMENT C:

CLASSROOM NORM DAILY GOAL

- ❑ I will use a respectful **tone** and appropriate language
- ❑ I will **wait** for other people to share their ideas and will **not interrupt** them
- ❑ I will demonstrate active listening by making eye contact and using appropriate **body language**
- ❑ I will **paraphrase** what other people said to show that I understood their claims
- ❑ I will utilize **Claims**, **Reasoning** and **Evidence** when sharing my thoughts

My goal for today is to:

SUPPLEMENT D:

Accountable to the Learning Community	**Listen** Pay attention to the statements of others. 	**Summarize** Restate the ideas of a previous speaker in new language. 	**Build** Add to the statement of a previous speaker. 	**Mark** Direct attention to the importance of another's statement. 
Accountable to the Knowledge	**Verify** Check your understanding of previous statements & knowledge. 	**Unpack** Explain how you arrived at your answer. 	**Support** Give examples & evidence to support your answer. 	**Link** Point out the relationships among previous statements & knowledge. 
Accountable to Rigorous Thinking	**Defend** Defend your reasoning against a different point of view. 	**Challenge** Ask a previous speaker to explain & provide evidence for a statement. 	**Combine** Incorporate knowledge from multiple resources to form your ideas. 	**Predict** Draw conclusions about what might happen next, or as a result of ideas. 

Accountable Talk

SUPPLEMENT E:

EXIT TICKET

Self-reflection 1:

What did you do well during the discussion?

Were you able to achieve your goal?

What is one skill that you want to build on for the next discussion?

Self-reflection 2:

What are 2 things you learned today from your partner (s) during the discussion?
Feedback for [teacher] on the [topic/activity] ➢ *I like/don't like _____ because…* ➢ *This could be more effective if…* ➢ *What if…*

LESSON 2

Lesson: Scientific Methodology 101

Timeframe: approximately 1-2 class periods

Target audience: Middle school – High school sophomore

- Rigor can be increased for high school by decreasing embedded UDL strategies

Materials: Scenario Organizers

Teacher prep:

Scientific Method scenarios - read over different scenarios prior to introducing to students:

https://nhs.newburyport.k12.ma.us/subsites/ehobbs/documents/Biology/biology%20Unit%201/Scientific%20methods/Scientific%20Method%20scenarios.pdf

https://www.biologycorner.com/worksheets/sci_method_scenarios.html

Supplement A: Organizers for scenarios

Key components of a Manuscript:

https://www.emerginginvestigators.org/submissions/parts-scientific-manuscript

Lesson:

Interactive Workshop: Scientific Methodology 101

- Students will be given a brief introduction to the objectives:
    - Identify the different parts of the Scientific Method

- (*TURN AND TALK*) Students will be asked a scientific/life question and, in pairs, asked what steps they would perform to answer that question or resolve the issue. The objective is to navigate students towards utilizing the Scientific Method. Utilize a scientific question that your class would be most interested in based on the demographics of your class. Perhaps utilize a daily life obstacle that illustrates how the Scientific Method is utilized in every decision we make both consciously or subconsciously and not only in labs. The students, at a minimum, should utilize basic Scientific Method structure: Question, Hypothesis, Materials, Procedures, Test, Analysis and Conclusion.

- (*WHOLE GROUP DISCUSSION*) Paired groups will share out during whole-group discussion. Ensure that every paired group shares.

- (*INTERACTIVE LECTURE*) Teacher will ask students to provide more background on the necessary steps for completing a scientific research project. The steps should include asking a testable question, generating a hypothesis, designing an experiment that tests the hypothesis, generating data, analyzing data, and communicating scientific findings through publication.

- (*GROUPING*) Teacher will break class into groups of 3 (if 4 then role will be observer) and assign roles: Leader, Recorder and Advocate.

    - The leader will ensure that the group is being productive and organized. The Recorder will be the scribe. The Advocate will ensure that the parts of the Scientific Method are being properly applied.

    - Each role will get extra credit points: Leader (10), Advocate (9) and the Recorder & Observer (8). Students will be able to maintain their "extra credit" points if, when the teacher walks over to speak with the respective group, they are on-task with their respective roles.

    - In order to increase ownership of tasks: (A) remind students that the roles rotate each time there is group work so each person gets a turn at each respective role, (B) remind students the "extra credit" points can be added to quizzes and tests in accordance to the students and teachers preference.

- (*GROUP PRACTICE*) Teacher will provide each group with a different scenario (*Supplement A*). The groups will have to utilize the Scientific Method to solve the scenario.

- (*INTRODUCTION PEER REVIEW*) The teacher will then collect the group work and randomly assign each group another groups work, along with the respective scenario.

    - Each group will then provide constructive feedback on: (A) the proper utilization of the Scientific Method and (B) the viability of the solution.

    - The initial feedback should be provide some specific feedback in-nature:
        - For each part of the Scientific Method students should state whether the respective part is clear and provide constructive feedback or questions. Peer review requires establishing an accountable culture that begins with Accountable Talk and will be implemented fully by the final lesson with more focused feedback.

        - Once students receive their reviewed work back, they should edit their work according to the constructive feedback/questions as a homework assignment or done in-class if time allows.

- (*CLOSING*) Whole group discussion focused on the concept of how the Scientific Method is key to all decisions we make. Teacher will close discussion by seguing that there is an alignment with the Scientific Method and the key components of a Manuscript.

- (EXIT TICKET) 3-2-1: 3 Things the student learned, 2 things they still wonder and 1 question that remains.

SUPPLEMENT A:

Practice Identifying Parts of the Scientific Method with Organizer

Directions: The following are experimental scenarios. Read the experiments and then identify the components of the scientific method by completing the graphic organizer provided.

Experimental Scenario #1

A student investigated whether ants dig more tunnels in the light or in the dark. She thought that ants used the filtered light that penetrated the upper layers of earth and would dig more tunnels during the daytime. Ten ant colonies were set up in commercial ant farms with the same number and type of ants per ant farm. The same amount of food was given to each colony, and the colonies were in the same temperature. Five of the colonies were exposed to normal room light and five were covered with black construction paper so they did not receive light. Every other day for three weeks the length of the tunnels was measured in millimeter using a string and a ruler. Averages for the light and dark groups for each measured were then computed. The averages are listed in the following chart.

Length of Tunnels (mm) Constructed by Ants in Different Light Conditions

Day	Light	Dark
1	5	7
3	10	15
5	20	25
7	26	32
9	32	47
11	50	62
13	61	93
15	66	110
17	90	115
19	95	120
21	103	136

Experimental Scenario #2

A student investigated the effect of radiation on the germination of bean seeds. He thought that exposure to radiation would limit the seeds ability to germinate (grow) much like ultra-violet light causing skin cancer. Three hundred seeds were soaked in distilled water for one hour. They were then divided into three groups. One group was placed in a microwave oven on high for three seconds. Another group was microwaved on high for six seconds. The last group was not microwaved. The seeds were then planted in three separate flats and given the same amount of water. The seeds were then planted in three separate flats and given the same amount of water. The flats were placed in a location with a constant temperature of approximately 27 degrees Celsius. Each day for two weeks the number of seeds that germinated each group was recorded.

Total Number of Bean Seeds Germinated after Microwave Radiation

Three Seconds of Radiation	Six Seconds of Radiation	No Radiation
54	26	88

Experimental Scenario #3

A student investigated the effect of aged-grass compost (fertilizer made from decaying plant material) on the growth of bean plants. She thought that the compost would provide extra nutrients and make plants grow faster. Thirty bean seeds were divided into three groups and planted in different flats (boxes). All seeds germinated after 12 days and were allowed to grow for five days. The flats were ach given the same amount of water and the same amount of light. Flat A was then fertilized with 3-month old compost; Flat B was given 6-month old compost; and Flat C was given no compost. At the end of 14 days the height of each plant was measured in centimeters.

Final Heights of Bean Plants

3-month old Compost	6-month old Compost	No Compost
7.6	10.1	6.5
5.4	9.5	7.2
8.2	12.1	8.4
9.3	13.0	11.0
8.2	8.5	6.9
6.9	13.1	6.8
7.3	12.4	6.3
9.4	11.6	10.7
10.2	14.8	9.9
12.0	10.8	10.6

Analysis of Experimental Scenarios

– Graphic Organizer –

PROBLEM/OBSERVATION:

QUESTION:

HYPOTHESIS:

EXPERIMENT:

Procedures:

Independent Variable:

Dependent Variable:

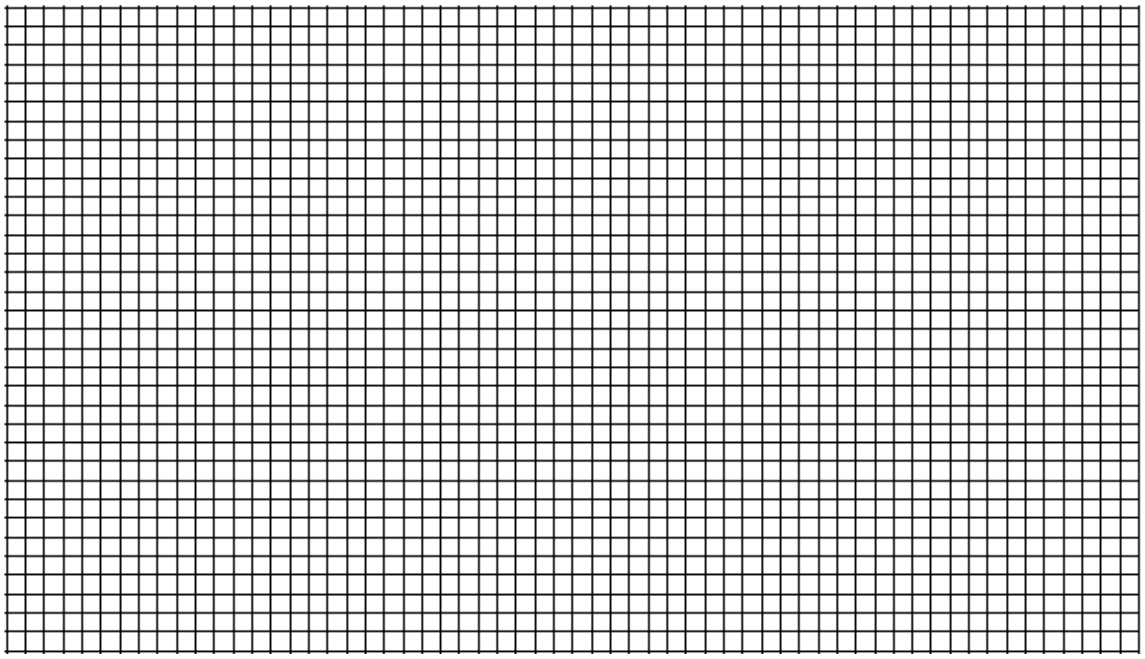
Controls:

Control Group:

Experimental Group(s):

DATA GRAPHING

Y-Variable=



X-Variable=

ANALYSIS:

CONCLUSION:

LESSON 3

Lesson: Identifying flaws in Experimental Designs

Timeframe: approximately 1 - 2 class periods

Target audience: Middle school – High school

- Rigor can be increased for high school by decreasing embedded UDL strategies

Materials: Experimental Design Vocabulary activity sheet, Experimental Design Exploration activity sheet**,** 6 experimental design scenarios, Classroom Daily Goals slip, Exit Ticket slips

Teacher prep:

Supplement A: Classroom Norm Daily Goal

Supplement B: Experimental Design Vocabulary activity

Supplement C: Experimental Design Exploration activity

Gallery Walk

- Format summary
  - https://serc.carleton.edu/introgeo/gallerywalk/what.html
- Activity
  - 6 stations
    - One experimental design scenario per station
  - Divide students into groups of 2-3
    - They can only talk to each other and no other group (deduct points if caught talking to other groups)
  - Students will answer all questions in lab notebook, or provide hard copy of the questions. Answers should follow the Claims-Reasoning-Evidence format
  - Teacher will signal when it is time to move to next station
    - Provide "extra credit" hard-copy questions for students who complete their respective station prior to signal. They can be completed for hw.
      - https://www.emerginginvestigators.org/classroom_resources

Station 1 – Experimental Design - Case #1
Supplement D: Experimental Design - Case #1

Station 2 – Experimental Design - Case #2
Supplement E: Experimental Design - Case #2

Station 3 – Experimental Design - Case #3
Appendix F: Experimental Design - Case #3

Station 4 – Experimental Design - Case #4
Supplement G: Experimental Design - Case #4

Station 5 – Experimental Design - Case #5
Supplement H: Experimental Design - Case #5

Station 6 – Experimental Design - Case #6
Supplement I: Experimental Design - Case #6

Lesson:

Gallery Walk: Identifying flaws in Experimental Designs

- *Create 6 stations with 1 experimental design scenario per station. Prepare extra credit question pile and place at each station.*
- *Students will be given a brief introduction to the objectives:*
    - Identifying flaws in Experimental Designs
- (*ACCOUNTABLE TALK*) Teacher will begin class by having students record their Classroom Norm Daily Goal (Supplement A) in their lab notebooks.
- *(INTERACTIVE LECTURE)* Teacher will speak on the importance of designing an experiment that is well structured. Teacher should emphasize that a poorly structured experimental design will create a myriad of problems that will sabotage the entire experiment. Teacher will define the following terms: Independent Variables, Dependent Variables and Control and provide examples.
- *(GROUP PRACTICE)* Teacher will provide Supplement B (Experimental Design Vocabulary worksheet) to all students. Students will Turn and Talk and work on the activity in pairs.
- *(WHOLE GROUP)* Teacher will provide each group with whiteboards and all groups will display answers for each question respectively. Teacher will provide feedback on wrong answers. This is an opportunity to re-teach the misconception.
- *(INDEPENDENT PRACTICE)* Teacher will provide Supplement C (Experimental Design Example) to all students. Students will work independently on the activity.
- *(WHOLE GROUP)* Teacher will provide each student with a whiteboard and all students will display answers for each question respectively. Teacher will provide feedback on wrong answers. This is an opportunity to re-teach the misconception.
- *(GALLERY WALK *outlined in Teacher Prep notes**)* Teacher will explain the Gallery Walk and the expectations. Students will be divided into groups of 2-3. Once in groups, they will have 2-3 minutes to compile questions about the activity. Teacher will then answer additional questions whole-group prior to beginning of activity.
- (EXIT TICKETS) Students will define Independent Variable, Dependent Variable and Control.

Supplement A:

CLASSROOM NORM DAILY GOAL

- ❑ I will use a respectful **tone** and appropriate language
- ❑ I will **wait** for other people to share their ideas and will **not interrupt** them
- ❑ I will demonstrate active listening by making eye contact and using appropriate **body language**
- ❑ I will **paraphrase** what other people said to show that I understood their claims
- ❑ I will utilize **Claims**, **Reasoning** and **Evidence** when sharing my thoughts

My goal for today is to:

Supplement B:

Experimental Design Vocabulary

Name _____ Date _____ Period _____

DIRECTIONS: Carefully read the paragraph and answer the questions.

Chris wanted to test the effect of diet pills on how tall the tomato plants in his garden would grow. He took two pots, filled them with dirt from the same bag, and planted four tomato plants in each. He watered one planter with tap water, and he watered the other planter with tap water mixed with dissolved diet pills. The plants were in the same location to ensure they got the same amount of sunlight, and the water was measured so that each pot received the same amount of water. He measured their height at the end of each week for eight weeks, and averaged the height of the four plants in each pot. He then graphed the results to show how the diet pills affected the height of the plants. 1. What is the independent variable of this experiment?

_____

_____ 2.

What is the dependent variable of this experiment?

_____

_____ 3.

What is the control?

_____

_____ 4.

List the constants in this experiment.

_____

_____ 5.

How many trials were ran for this experiment?

_____

_____ 6.

Write a hypothesis for this experiment in the If/Then style.

_____

_____

_____

Supplement C:

Experimental Design- Explore

Name _____ Date _____ Period ____

DIRECTIONS: Carefully read the paragraph below. Answer the following questions in complete sentences.

During gym class Sally noticed that her friend Melissa always ran faster than her. Sally knew that they exercised equally, so she wondered what could cause Melissa to run so fast. Sally began to compare herself and Melissa to see what could cause the difference in speeds. She noticed that Melissa was taller and wondered if height affected speed. Sally predicted that taller people were able to run faster, but wanted to check her prediction. She asked her gym teacher if she could test her idea because the class was all girls and she thought this would help her get accurate results. Sally measured all of her classmates' height in centimeters and recorded it in her chart. Each classmate then ran one mile while Sally timed them with a stopwatch and recorded the data in seconds. She then began to review her data and look for the answer to her question.

1. What question is Sally trying to answer?

_____

_____

2. What made her want to answer this question?

_____

_____

3. What is being measured or observed in this experiment?

_____

_____

4. Are the observations recorded in words or numbers?

_____

_____

5. What factor does Sally think might cause the measurement to change?

_____

_____

6. What parts of the experiment were kept the same throughout?

_____

_____

7. Is there a standard of comparison in this experiment (something she compared everyone to)?

_____

_____

8. How many times was the experiment completed?

_____

_____

Supplement D:

Experimental Design - Case #1

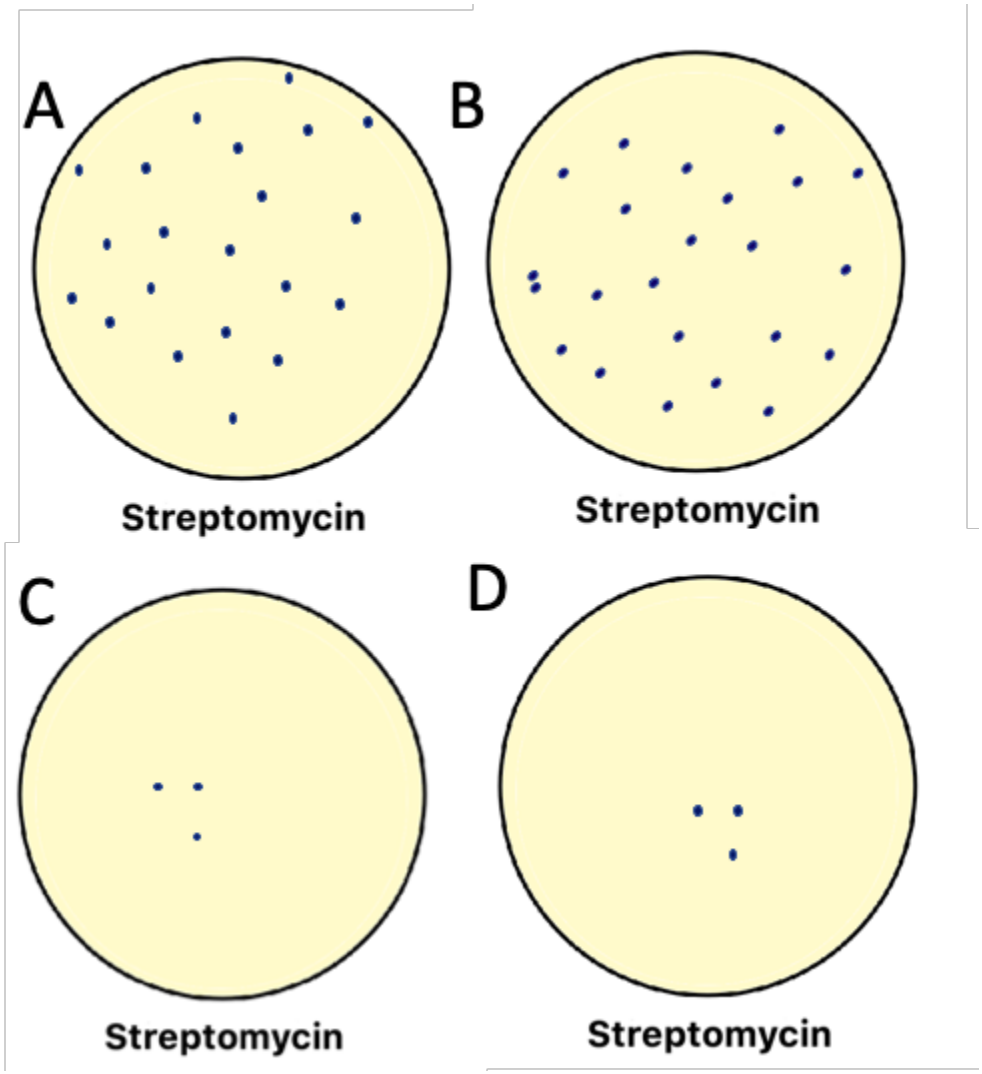
Hypothesis: Leaves from bushes in a local park contain more bacteria than leaves from trees in the same park.

Methods: Four sites were sampled with sterile cotton swabs (swabs run three times across the surface of the leaves): two sites from shrubs in the Arnold Arboretum, and two from green leaves on the lower branches of trees, also in the Arnold Arboretum. Swabs were stored in the refrigerator, then swished in 0.3 milliliters each of phosphate-buffered saline. 100 microliters of this suspension was spread onto each agar plate with Tsoy media, with or without streptomycin.

Results:

Figure 1- Bacteria from leaves on Tsoy agar plates

Suspensions of swabs from hedges (A,B) or trees of a nearby park (C,D) were spread on Tsoy with 10 µg/mL streptomycin



Discussion: This data supports our hypothesis. More bacteria grew on the samples from hedges than the samples from trees. This difference is particularly stark since neither of the two replicates from hedges showed very much bacterial growth.

Question for Students: Is this experiment ready to go into a JEI paper, or is there something that it is missing? Explain using the Claim-Reasoning-Evidence technique.

Supplement E:

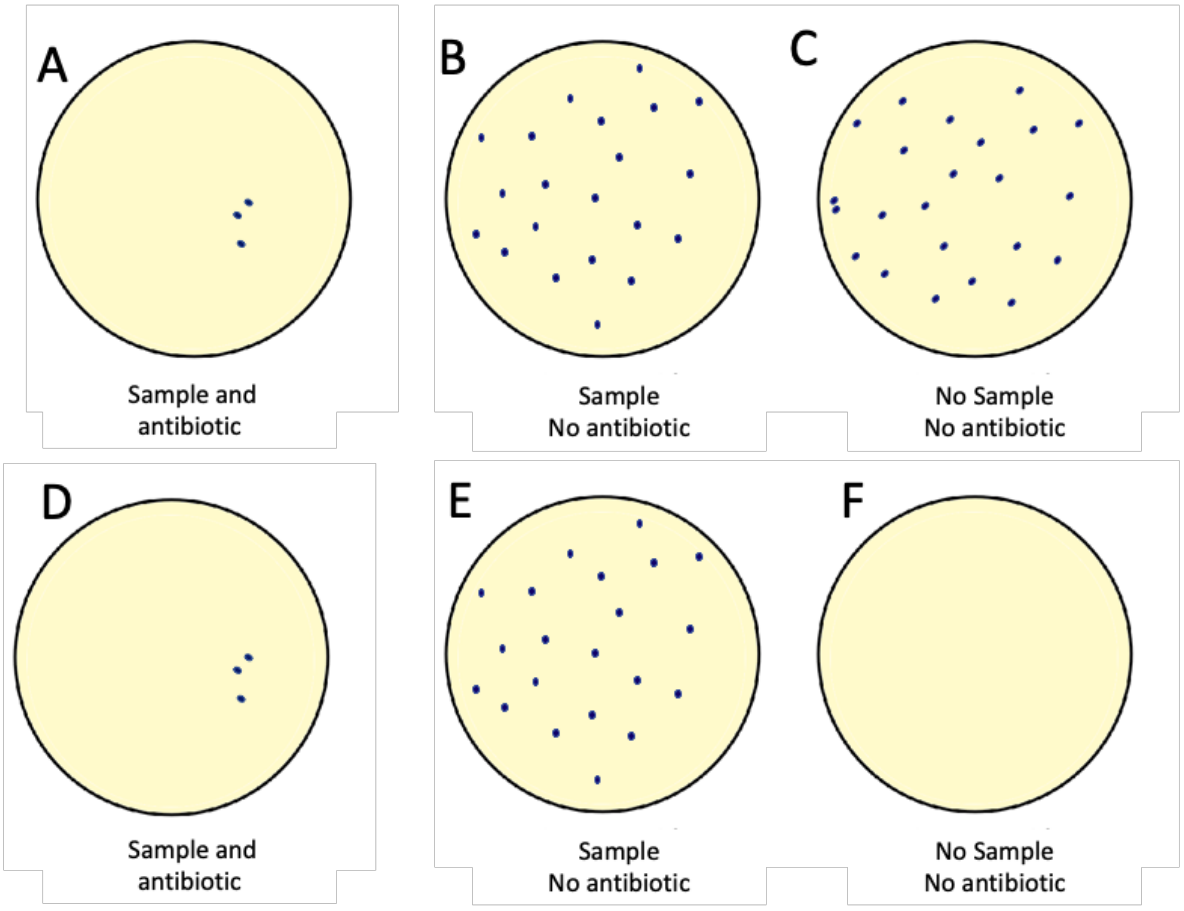
Examples of the Scientific Method - Case #2

Hypothesis: Lettuce purchased from the supermarket will have less antibiotic bacteria than lettuce from the local farmer's market

Methods: A head of lettuce was bought from the local Star Market and from the local farmers market. An exterior leaf of each sample was removed and swabbed. Swabs were stored in the refrigerator, then swished in 0.3 milliliters each of phosphate-buffered saline. 100 microliters of this suspension was spread onto each agar plate with Tsoy media, with or without streptomycin.

Results:
Figure 1- Bacteria from leaves on Tsoy agar plates

Samples from lettuce from from the grocery store (A,B) or the farmers market (D,E) were spread on Tsoy with or without 10 µg/mL streptomycin. Two controls with no sample were also used (C, F).



Discussion: The results of our experiment do not support our hypothesis because both samples grew well when there was no antibiotic but grew poorly when an antibiotic was added. This means the bacteria in both samples of lettuce were not antibiotic resistant.

Question for Students: Does the data support this result? Explain using the Claim-Reasoning-Evidence technique.

Supplement F:

Examples of the Scientific Method - Case #3

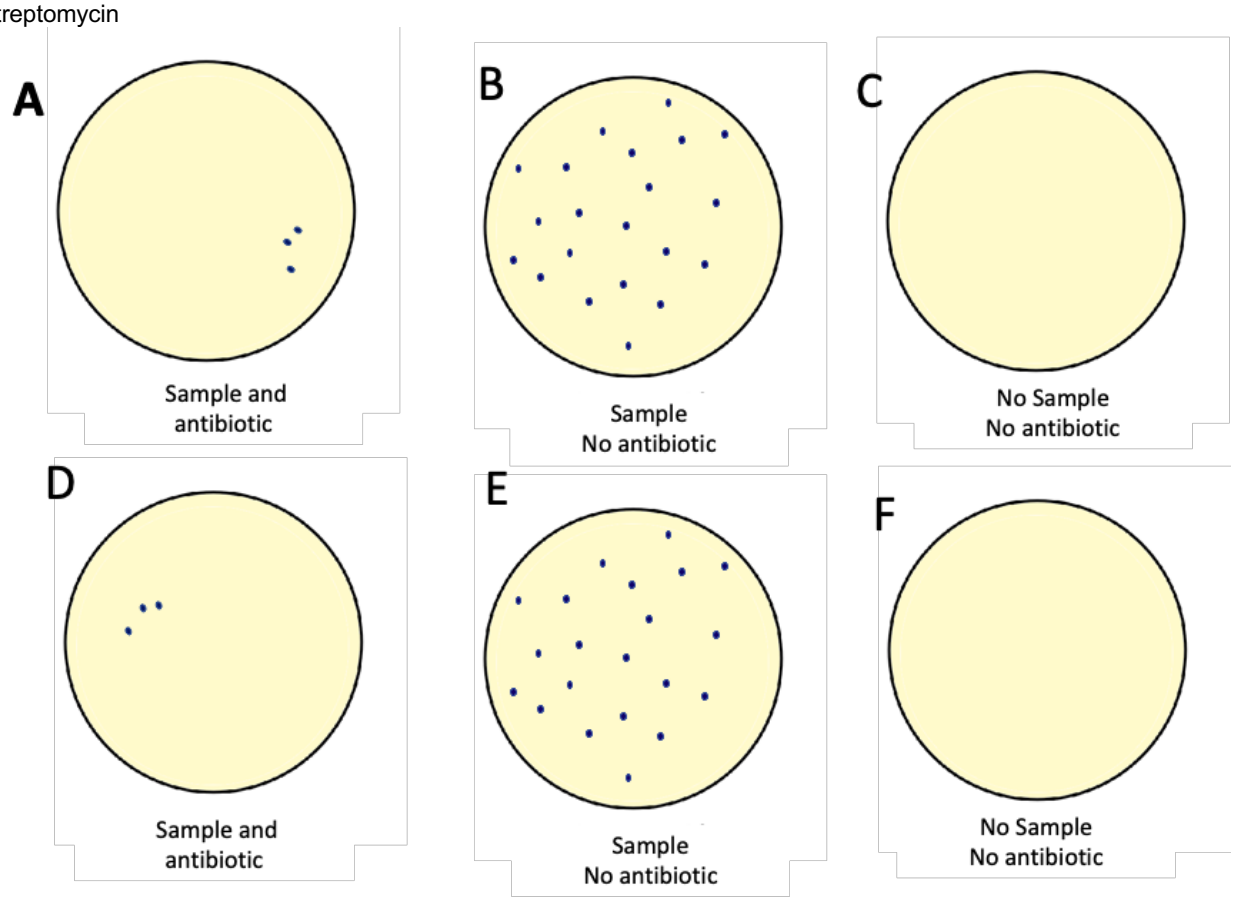
Hypothesis: Soil samples will have more antibiotic resistant bacteria after mosquito spraying than before mosquito spraying.

Methods: Two sites were sampled with sterile cotton swabs (swabs were poked into the uppermost layer of dirt). The first site was sampled one day before town-wide mosquito spraying and the second site was sampled one week after mosquito spraying. Both samples were taken from the edge of a lake of standing water. Swabs were stored in the refrigerator, then swished in 0.3 milliliters each of phosphate-buffered saline. 100 microliters of this suspension was spread onto each agar plate with Tsoy media, with or without streptomycin.

Results:

Figure 1- Tsoy agar plates

Soil samples before (A, B) and after (D, E) spraying were spread on Tsoy with or without 10 µg/mL streptomycin



Discussion

My hypothesis that mosquito spraying would not have an effect on the antibiotic resistance was incorrect. The plates show that both before and after spraying, there are few bacteria growing in the presence of antibiotics. We believe this a real representation of the soil bacteria populations because no contaminating bacteria grew on the blank plates.

Question for Students: In this experiment, the results did not support the hypothesis. Before submitting a paper with this experiment to JEI, should the authors change their hypothesis? Explain using the Claim-Reasoning-Evidence technique.

Supplement G:

Examples of the Scientific Method - Case #4

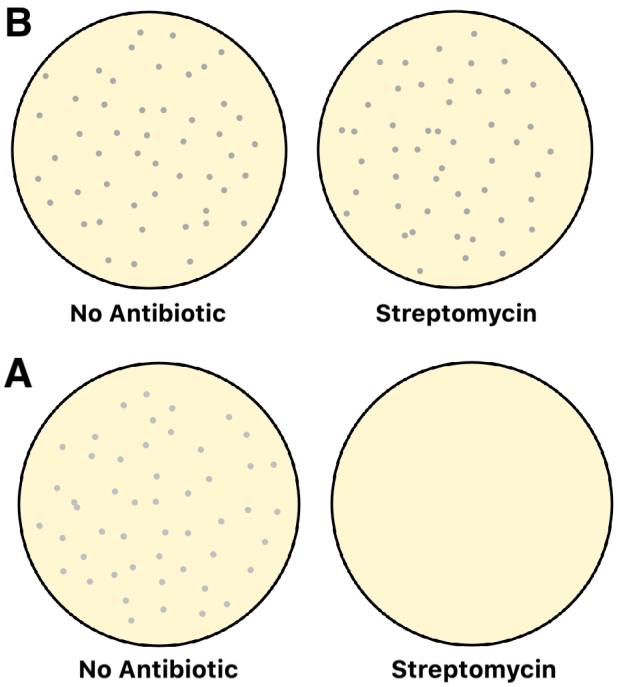
Hypothesis: Soil from a forest contains a higher proportion of streptomycin-resistant bacteria than soil from an urban grass field

Methods: Four sites were sampled with sterile cotton swabs (swabs were poked into the uppermost layer of dirt): two sites in tree-covered areas of the Arnold Arboretum, and two in grassy areas of a park in nearby Jamaica Plain. Swabs were stored in the refrigerator, then swished in 0.3 milliliters each of phosphate-buffered saline. 100 microliters of this suspension was spread onto each agar plate with Tsoy media, with or without streptomycin. Strains of *Escherichia coli* with and without genetically inserted streptomycin resistance were also spread on the same plates.

Results:

Figure 1- Strains of *E. coli* on Tsoy agar plates

Suspensions of *E. coli* that are susceptible (A) or resistant (B) to streptomycin were spread on Tsoy with or without 10 µg/mL streptomycin

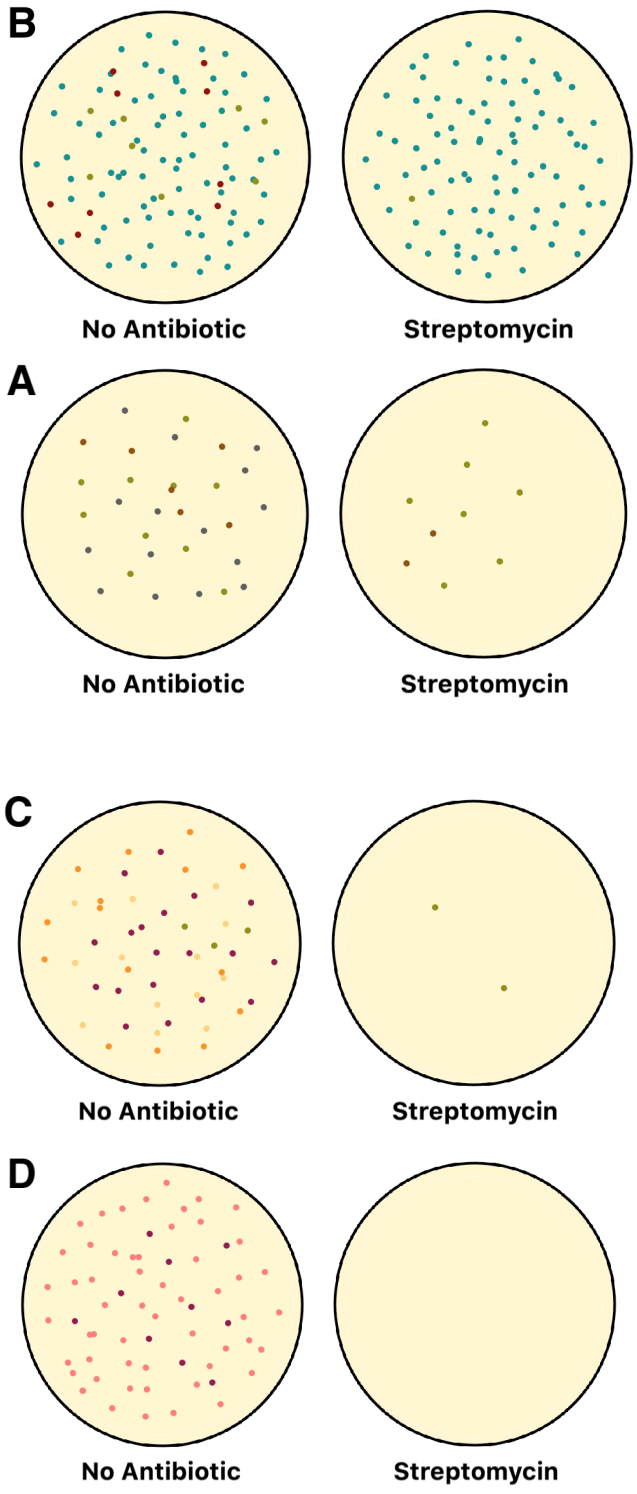


As expected, the *E. coli* strain with no known streptomycin resistance produced many colonies on plain Tsoy agar, but no colonies on media with streptomycin (Figure 1A). Meanwhile, the *E. coli* strain with genetically encoded streptomycin resistance produced approximately equal numbers of colonies on media with and without streptomycin (Figure 1B).

For both soil isolates from forested areas of Arnold Arboretum, there were colonies present on plain Tsoy agar and Tsoy agar containing streptomycin (Figure 2A,B) - though there were fewer colonies on the media with streptomycin, especially for soil from the first site (Figure 2A). Meanwhile, the soil isolates from grassy areas in Jamaica Plain had far fewer colonies on media with streptomycin, when compared to plain Tsoy (Figure 2C,D). The second grassy site isolate, despite producing many colonies when plated on plain Tsoy, produced none at all on Tsoy with streptomycin (Figure 2D).

Figure 2- Bacteria from soil on Tsoy agar plates

Suspensions of dirt from forested sites (A,B) or grassy areas of a nearby park (C,D) were spread on Tsoy with or without 10 µg/mL streptomycin



Discussion: The results of our experiment support our hypothesis that soil from a forested area contains a higher proportion of antibiotic-resistant bacteria than soil from a grassy field, since there were plenty of bacterial colonies on the streptomycin-containing plates from "forested area" dirt suspensions, and few to no colonies on the streptomycin-containing plates from "grassy field" dirt suspensions. This difference is especially notable since plenty of colonies grew on the streptomycin-free agar plates from all dirt suspensions tested.

Question for Students: Is this experiment ready to go into a JEI paper, or is there something that it is missing? Explain using the Claim-Reasoning-Evidence technique.

Supplement H:

Examples of the Scientific Method - Case #5

Hypothesis: There are more bacteria in the drain of a kitchen sink than the drain of a bathroom sink, but the bacteria in the bathroom sink's drain are more likely to be ampicillin resistant.

Methods: Sterile cotton swabs were used to sample the drain of a bathroom sink and the drain of a kitchen sink, both in the same Dorchester apartment. Swabs were stored in the refrigerator, then swished in 0.3 milliliters each of phosphate-buffered saline. 100 microliters of this suspension was spread onto each agar plate with Tsoy media, with or without ampicillin. Strains of *Escherichia coli* with and without genetically inserted ampicillin resistance were also spread on the same plates.

Results:

Figure 1- Strains of *E. coli* on Tsoy agar plates

Suspensions of *E. coli* that are susceptible (A) or resistant (B) to ampicillin were spread on Tsoy with or without 20 µg/mL ampicillin

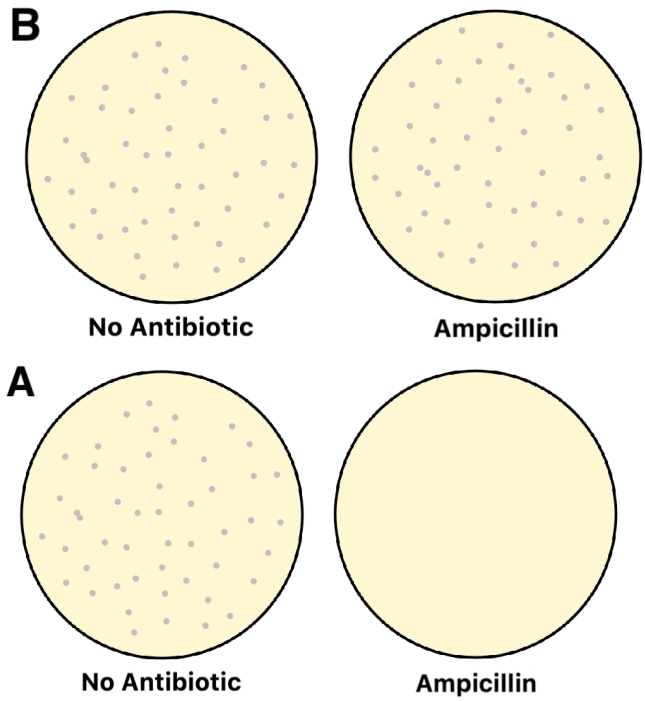
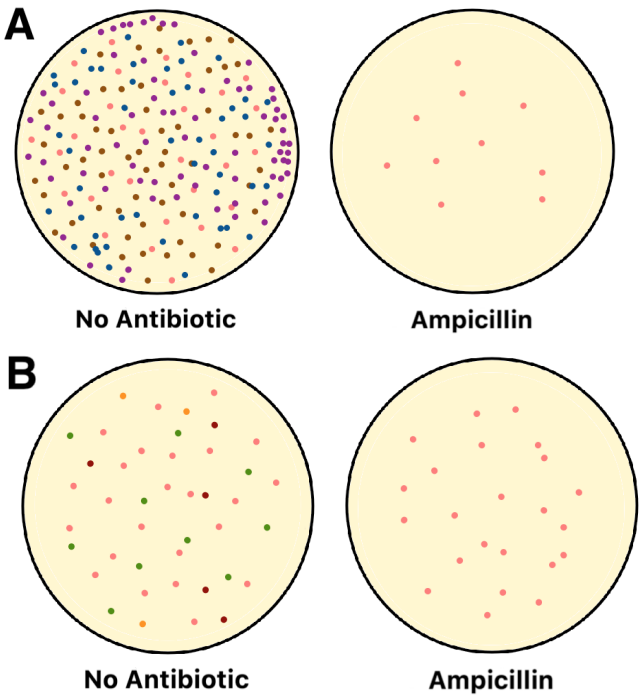


Figure 1- Strains of *E. coli* on Tsoy agar plates

Suspensions from swabs of (A) a kitchen sink's drain or (B) a bathroom sink's drain were spread on Tsoy with or without 20 µg/mL ampicillin



As expected, the *E. coli* strain with no known ampicillin resistance produced many colonies on plain Tsoy agar, but no colonies on media with ampicillin (Figure 1A). Meanwhile, the *E. coli* strain with genetically encoded ampicillin resistance produced approximately equal numbers of colonies on media with and without ampicillin (Figure 1B).

The swab from the kitchen sink drain produced lots of colonies on the plate with no antibiotic, but only 10 colonies on the plate with ampicillin (Figure 2A). Meanwhile, the swab from the bathroom sink drain had fewer colonies on the plate with no antibiotic (relative to the kitchen sink drain), but had more than 20 colonies on the plate with ampicillin (Figure 2B).

Discussion: The results of our experiment support our hypothesis that the drain of a kitchen sink has more bacteria than the drain of a bathroom sink, but that the bacteria in the bathroom sink's drain are more likely to be resistant to ampicillin. Indeed, despite the overall difference in bacterial number, there were actually more total colonies on the ampicillin plate from the bathroom sink drain versus the plate from the kitchen sink drain.

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Question for Students: In this experiment, the results supported the hypothesis. If you were the author, would you send this in to JEI - or would you want to do another experiment? If you were to do another experiment, what would it test (and what would your hypothesis be)? Explain using the Claim-Reasoning-Evidence technique.
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Supplement J:

Examples of the Scientific Method - Case #6

Hypothesis: There are more bacteria in the drain of a kitchen sink than the drain of a bathroom sink, but the bacteria in the bathroom sink's drain are more likely to be ampicillin resistant.

Methods: Sterile cotton swabs were used to sample the drain of a bathroom sink and the drain of a kitchen sink, both in the same Dorchester apartment. Swabs were stored in the refrigerator, then swished in 0.3 milliliters each of phosphate-buffered saline. 100 microliters of this suspension was spread onto each agar plate with Tsoy media, with or without ampicillin. Strains of *Escherichia coli* with and without genetically inserted ampicillin resistance were also spread on the same plates.

Results:

Figure 1- Strains of *E. coli* on Tsoy agar plates

Suspensions of *E. coli* that are susceptible (A) or resistant (B) to ampicillin were spread on Tsoy with or without 20 µg/mL ampicillin

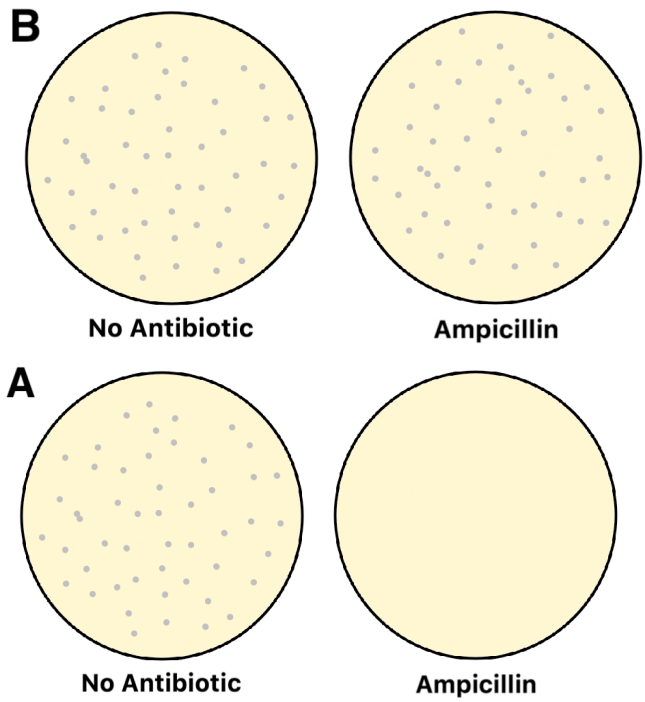
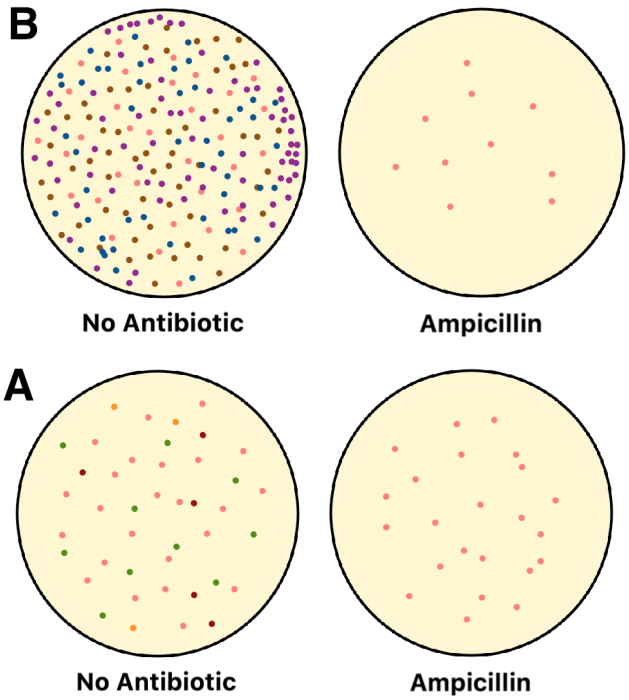


Figure 1- Strains of *E. coli* on Tsoy agar plates

Suspensions from swabs of (A) a kitchen sink's drain or (B) a bathroom sink's drain were spread on Tsoy with or without 20 µg/mL ampicillin



As expected, the *E. coli* strain with no known ampicillin resistance produced many colonies on plain Tsoy agar, but no colonies on media with ampicillin (Figure 1A). Meanwhile, the *E. coli* strain with genetically encoded ampicillin resistance produced approximately equal numbers of colonies on media with and without ampicillin (Figure 1B).

The swab from the kitchen sink drain produced almost 50 colonies on the plate with no antibiotic, and over 20 colonies on the plate with ampicillin (Figure 2A). Meanwhile, the swab from the bathroom sink drain had many more colonies on the plate with no antibiotic (relative to the kitchen sink drain), but had only 10 colonies on the plate with ampicillin (Figure 2B).

Discussion: The results of our experiment do not support our hypothesis that the drain of a kitchen sink has more bacteria than the drain of a bathroom sink, and that the bacteria in the bathroom sink's drain are more likely to be resistant to ampicillin. Indeed, the kitchen sink actually had fewer total bacteria - and they were much more likely to be resistant to ampicillin.

~~~~~~

Question for Students: In this experiment, the results did not support the hypothesis. If you were the author, would you send this in to JEI - or would you want to do another experiment? If you were to do another experiment, what would it test (and what would your hypothesis be)? Explain using the Claim-Reasoning-Evidence technique.
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LESSON 4

Lesson: Aligning the Scientific Method to Parts of a Manuscript

Timeframe: approximately 2-3 class periods

Target audience: Middle school – High school

- Rigor can be increased for high school by decreasing embedded UDL strategies
-

Materials: Copies of JEI articles if technology is not available, Introduction to Primary Literature activity worksheet, Manuscript Discovery worksheet, Classroom Daily Goals slip, Exit Ticket slips

Teacher prep:

Supplement A: Classroom Norm Daily Goal

Introduction to JEI

The Journal of Emerging Investigators (JEI) is an open-access journal that was founded at Harvard Medical School. JEI publishes original research conducted by middle and high school students nationally and internationally. JEI provides young scientists, under the guidance of a teacher or advisor, the opportunity to submit and gain feedback on original research and to publish their findings in a peer-reviewed scientific journal that can be accessed globally.

Conceptual premise for Scientific journals

Scientific journals represent the most vital means for disseminating research findings and are usually specialized for different academic disciplines or subdisciplines. Often, the research challenges common assumptions and/or the research data presented in the published scientific literature in order to gain a clearer understanding of the facts and findings. Depending upon the policies of a given journal, articles may include reports of original research, re-analyses of others' research, reviews of the literature in a specific area, proposals of new but untested theories, or opinion pieces.

Cornell Note Taking System

- Overview w/videos:
  - ***http://lsc.cornell.edu/how-to-study/taking-notes/cornell-note-taking-system/***
- How-to:
  - *http://coe.jmu.edu/learningtoolbox/cornellnotes.html*
  - http://lsc.cornell.edu/notes.html

Sample JEI article

- Original:
  - ***https://www.emerginginvestigators.org/articles/bird-feeding-experiment-do-wild-birds-feed-in-a-more-wooded-or-exposed-area/pdf***
- Annotated:
  - ***https://www.emerginginvestigators.org/documents/annotated_manuscript***

Supplement B: Manuscript Discovery worksheet

Parts of a Manuscript

https://www.emerginginvestigators.org/submissions/parts-scientific-manuscript#intro

Introduction to Scientific Primary Literature activity worksheet

This exercise introduces the concept of primary literature to students, describes peer review, and requires students to actively read a JEI manuscript.

https://www.emerginginvestigators.org/system/classroom_resources/worksheets/000/000/001/original/699a5a6b6b6cb672c5a7b80170c08482911a7c1b.pdf

JEI article database

https://www.emerginginvestigators.org/articles

Supplement C: Exit Ticket

Lesson:

Aligning the Scientific Method to Parts of a Manuscript

- *Students will be provided a lab notebook to: outline main parts of a manuscript (Title Page, Summary, Introduction, Results, Data Figures, Discussion, Materials and Methods, and References); record observations for their experiments; group/individual activities and general notes.*

- Students will be given a brief introduction to the objectives:
    - Identify parts of a Manuscript
    - Align the parts of the Scientific Method to parts of a Manuscript

- (*ACCOUNTABLE TALK*) Teacher will begin class by having students record their Classroom Norm Daily Goal in their lab notebooks.

- (*INTERACTIVE LECTURE*) Teacher will ask the students "what is the purpose of journals?". Once students have shared out, teacher will introduce JEI and the concept of scientific journals. After students have shared their thoughts, the teacher will explain that JEI articles are written by students, but they are based on a structure utilized by real scientists. This will be supplemented with the conceptual premise provided in Teacher prep area. Teacher will then ask students why it is important to take reflective notes. After students have provided answers, utilize videos and overview to provide reasoning for taking reflective notes. Then provide a structure via the Cornell Note Taking System.

- (*JIGSAW ACTIVITY*) Teacher will divide students into groups of 5. Provide each student with the Manuscript Discovery Organizer (*Supplement B*) and the original JEI article (Bird Feeding experiment). Students will then take part in the Jigsaw activity: Each student will pick one of the 5 parts of a manuscript (Summary, Introduction, Results, Discussions, and Methods). When all students have answered their respective questions, they will then "teach" the other students by providing an overview of their answers. All answers will be noted in their lab notebooks. Students will take notes from the other students overview of each respective part.

- (*INTERACTIVE LECTURE*) Begin by asking students to provide their own insights on each part of a manuscript before filling in the gaps of knowledge. Teacher will then define the different parts of a Manuscript. All notes will be written in their lab notebooks.

- (*INDIVIDUAL PRACTICE*) Teacher will provide students with the JEI website link to the JEI database of articles. Students will be tasked with finding a JEI article that interests them from the JEI website and complete the Introduction to Scientific Primary Literature activity worksheet (*Supplement B*).

    - **if students do not have access to technology, take a poll on student Science interests, find JEI articles aligned with student interests and provide JEI articles as handouts.*

- *(INDIVIDUAL PRESENTATION)* Teacher will ask students to briefly present to the original group of 5: *what the motivations were behind the study, what was the hypothesis, what experiments they did, what conclusions were drawn, and their own follow-up questions that were elicited from skimming the article.*

- *(EXIT TICKET) List the parts of a Manuscript and align the Manuscript pats with the parts of Scientific Method.*

Supplement A:

CLASSROOM NORM DAILY GOAL

- ❑ I will use a respectful **tone** and appropriate language
- ❑ I will **wait** for other people to share their ideas and will **not interrupt** them
- ❑ I will demonstrate active listening by making eye contact and using appropriate **body language**
- ❑ I will **paraphrase** what other people said to show that I understood their claims
- ❑ I will utilize **Claims**, **Reasoning** and **Evidence** when sharing my thoughts

My goal for today is to:

Supplement B:

Name:_____Date:_____

MANUSCRIPT DISCOVERY

Directions: Read your groups part of the manuscript. Answer all questions in your lab notebook. Be prepared to "teach" the class what you discovered.

PARTS OF A MANUSCRIPT	DISCOVERY QUESTIONS	NOTES
SUMMARY	A. What is the purpose of an Summary? B. What parts of the Scientific Method are in this section? C. For this particular article, provide the respective information for each part you have identified.	
INTRODUCTION	A. What is the purpose of an Introduction? B. What parts of the Scientific Method are in this section? C. Why should we care about his topic? D. What is the greater context of the question?	

RESULTS	A. What is the purpose of the Results section? B. What parts of the Scientific Method are in this section? C. Provide a brief overview of the experiment. D. What does the data tell us?	
DISCUSSION	A. What is the purpose of the Discussion section? B. What parts of the Scientific Method are in this section? C. Briefly summarize the conclusions drawn from the data. D. Briefly discuss factors that could have influenced the results.	
METHODS	A. What is the purpose of the Methods section? B. What parts of the Scientific Method are in this section? C. List the different steps taken during the experiment. D. What materials were used?	

Supplement C:

EXIT TICKET

Self-reflection 1:

What did you do well during the discussion?

Were you able to achieve your goal?

What is one skill that you want to build on for the next discussion?

Self-reflection 2:

What are 2 things you learned today from your partner (s) during the discussion?
Feedback for [teacher] on the [topic/activity] ➢ *I like/don't like _____ because…* ➢ *This could be more effective if…* ➢ *What if…*

LESSON 5

Lesson: Deeper exploration of a Manuscript via a Gallery Walk

Timeframe: approximately 1 - 2 class periods

Target audience: Middle school – High school

- Rigor can be increased for high school by decreasing embedded UDL strategies

Materials: Printed copies of JEI articles if technology is not available, Sample JEI articles, Activity worksheets, Peer Review rubric, Pre-submission article, Classroom Daily Goals slip, Exit Ticket slips

Teacher prep:

Supplement A: Classroom Norm Daily Goal

Gallery Walk

- Format summary
  - https://serc.carleton.edu/introgeo/gallerywalk/what.html
- Activity
  - 5 stations
    - Introduction, Methods, Results, Discussion, and Peer Review practice
  - Each station has 2 JEI articles
  - Divide students into groups of 2-3
    - They can only talk to each other and no other group (deduct points if caught talking to other groups)
  - Students will answer all questions in lab notebook, or provide hard copy of the questions
  - Teacher will signal when it is time to move to next station
    - Provide "extra credit" questions for students who complete their respective station prior to signal
      - https://www.emerginginvestigators.org/classroom_resources
  - Students will keep work in folders. Folders will be taken home once every student has completed every station (Peer review will be worked on in class but taken home with folder for completion)

Station 1 – Introduction

Sample article 1: https://www.emerginginvestigators.org/articles/the-impact-of-effective-density-and-compressive-strength-on-the-structure-of-crumpled-paper-balls/pdf

Sample article 2: https://www.emerginginvestigators.org/articles/the-impact-of-the-covid-19-pandemic-on-mental-health-of-teens/pdf

Supplement B: Introduction

Station 2: - Methods

Sample 1: https://www.emerginginvestigators.org/articles/physical-appearance-and-its-effect-on-trust/pdf

Sample 2: https://www.emerginginvestigators.org/articles/oled-screens-better-exhibit-the-color-black-than-lcd-screens/pdf

Supplement C: Methods activity sheet

Station 3: - Results

Sample 1: https://www.emerginginvestigators.org/articles/assigning-lightning-seasons-to-different-regions-in-the-united-states/pdf

Sample 2: https://www.emerginginvestigators.org/articles/electromagnetic-radiation-from-electronics-does-affect-plant-growth/pdf

Appendix D: Results activity sheet

Station 4: - Discussion

Sample 1: https://www.emerginginvestigators.org/articles/bacteria-and-antibiotic-resistance-in-school-bathrooms/pdf

Sample 2: https://www.emerginginvestigators.org/articles/examining-the-accuracy-of-dna-parentage-tests-using-computer-simulations-and-known-pedigrees/pdf

Supplement E: Discussion activity sheet

Station 5: - Peer Review

Supplement F: Peer Review Rubric

Supplement G: Peer Review article (pre-submission)

Supplement H: Exit Ticket

Lesson:

Gallery Walk: Deeper Exploration of a Manuscript

- *Create 4 stations with 2 JEI articles per station, or 8 stations with one article, to allow for groups of 2-3 students to move more freely between stations. The Peer Review station will only include one article and the rubric. Print out respective handouts for each station. Provide all students with a folder and all work will be kept in folder. Folder will be taken home only when all students have completed all stations. The fifth station, the Peer Review station, should be finished as homework but students will work on worksheet while at station.*
- *Students will be given a brief introduction to the objectives:*
    - Explore various manuscripts and identify key components
    - Peer review and provide constructively critical comments
- (*ACCOUNTABLE TALK*) Teacher will begin class by having students record their Classroom Norm Daily Goal (Appendix A) in their lab notebooks.
- *(INTERACTIVE LECTURE)* Teacher will explain the Gallery Walk and the expectations. Students will divide into groups of 2-3. Once in groups, they will have 2-3 minutes to compile questions about the activity. Teacher will then answer additional questions whole-group.
- (GALLERY WALK) *Outlined in Teacher Prep notes*
    - Peer Review article will be completed at home once ALL students have visited the respective station. All work should be collected in folders from each student.
- (EXIT TICKETS) Students will Rank the parts of the Manuscript easiest to hardest. Students should also answer the following question: “Why did you have difficulty?”

Supplement A:

CLASSROOM NORM DAILY GOAL

- ❑ I will use a respectful **tone** and appropriate language
- ❑ I will **wait** for other people to share their ideas and will **not interrupt** them
- ❑ I will demonstrate active listening by making eye contact and using appropriate **body language**
- ❑ I will **paraphrase** what other people said to show that I understood their claims
- ❑ I will utilize **Claims**, **Reasoning** and **Evidence** when sharing my thoughts

My goal for today is to:

Supplement B:

Introduction station

Name:_____Date:_____

Answer each question thoroughly. Provide your Claim, Reasoning and Evidence when applicable.

Is the purpose of the study clearly stated? What is the purpose?

Are the definitions provided for scientific terms (if applicable)?

Is Hypothesis clearly stated? If yes, please state.

Are the Independent and dependent variables defined (if applicable)? If yes, please state.

Is the study placed in context of related research? If applicable, what is the context?

Supplement C:

Methods station

Name:_____Date:_____

Answer each question thoroughly. Provide your Claim, Reasoning and Evidence when applicable.

Are the methods described in clear enough detail that someone unfamiliar with the study could repeat the experiment? List the steps.

Are the measurements clearly explained? List the measurements.

Is there an explanation provided for why pieces of equipment or other instruments were used? How was the equipment used and why?

Are the units of measurement (mL, cm, etc.) used correctly?

Supplement D:

Results station

Name:_____Date:_____

Answer each question thoroughly. Provide your Claim, Reasoning and Evidence when applicable.

Are the graphs properly displayed, with both axes identified? What are the two variables?

Are the units of measure provided? What are the units?

Are the results clearly displayed and easy to read?

What information can you garner from the graph(s)? Be specific.

Supplement E:

Discussion station

Name:_____Date:_____

Answer each question thoroughly. Provide your Claim, Reasoning and Evidence when applicable.

Are the results clearly explained? What were the results?

Is there a statement addressing whether data support hypothesis?

Why did the experiment yield these results? Were they expected? Why or why not? What might explain the results?

What additional experiments that might help further explore the research question.

Supplement F:

Peer Review Station

Peer Review Rubric

Directions: Use the checklist below to guide your review of a pre-submission JEI Manuscript.

Introduction:
___ Purpose of study clearly stated.
___ Definitions provided for scientific terms.
___ Hypothesis clearly stated (if applicable).
___ Independent and dependent variables defined (if applicable).
___ Study placed in context of related research.

Methods:
___ Methods described in clear enough detail that someone unfamiliar with the study could repeat the experiment.
___ Measurements clearly explained.
___ Explanation provided for why pieces of equipment or other instruments were used.
___ Units of measure (mL, cm, etc.) used correctly.

Results:
___ Graphs properly displayed, with both axes identified.
___ Units of measure provided.
___ Results clearly displayed and easy to read.

Discussion:
___ Results clearly explained.
___ Statement addressing whether data support hypothesis.
___ Further discussion of results; i.e.; why did the experiment yield these results? Were they expected? Why or why not? What might explain the results?
___ Discussion of additional experiments that might help further explore the research question.

General:
___ Paper is well written overall.
___ Report provides new insight or perspective in the field.

Do you recommend the paper for publication?
___ Strongly recommend.
___ Recommend, with revisions.
___ Do not recommend.

Explain your recommendation:

APPENDIX G:

Caffeine: Does Drinking Coffee Alter Performance and RPE Levels of a Teenage Athlete in both Aerobic and Anaerobic Exercises?

Abstract/Summary

The purpose of this study was to determine if ingesting caffeine in the form of coffee prior to workouts can enhance performance and alter RPE (Rating of Perceived Exertion) of teenage athletes for both endurance(aerobic) and strength(anaerobic) exercises. The hypotheses are that caffeine lowers RPE for both endurance and strength exercises compared to when workouts are performed without ingesting caffeine. However, performance will not be enhanced for the strength exercises but will be for endurance exercises. To answer this question, a 16 year old high school athlete (myself) was analyzed for a total of twelve days: three days consuming a cup of coffee (95 mg caffeine) one hour prior to running and three days drinking coffee one hour prior to performing strength exercises, and three days without for each test. For the endurance portion of the test, the athlete was to run two miles as fast as they could. Average heart rate and pace per mile were analyzed for three days with coffee and three days without, as well as RPE levels. For the strength portion, the athlete was required to do as many push-ups as possible in a one minute time frame. The results showed that caffeine ingestion an hour prior to exercise provided an advantage in endurance but had no impact on the strength portion. Additionally, RPE was indeed lower for the endurance portion but remained unchanged for the strength portion. Through this study, there is an implication behind why many professional athletes, specifically endurance athletes, consume coffee prior to races or games in order to enhance performance. Although caffeine is proven to provide an advantage for teenagers as well through this study, it can lead to much darker implications. Caffeine consumption has not been recommended for children, including teenagers, and if it is proven to provide an advantage in athletics, this could potentially lead in overconsumption of teenage athletes. These studies support overconsumption of energy drinks however (1). This is especially true as if consumed regularly, one could become more dependent on caffeine. Nevertheless, caffeine can enhance performance significantly and lead to lower RPE levels if ingested safely in moderation for the teenage endurance athlete.

Introduction:

To better understand if caffeine has similar effects on performance and RPE levels on both endurance and strength exercises on teenage athletes, caffeine's mechanisms on one must be considered. Caffeine, a substance most commonly found in coffee, but also many sports drinks, soft beverages, or energy supplements, is a stimulant. This substance is a drug, however, is the world's most consumed psychoactive drug, but legal for consumption. This stimulates the central nervous system as it is a part of the methylxanthine class(2).Many athletes consume cups of coffee prior to workouts, races, or games. Recent research has shown that caffeine has been proven to compete with adenosine receptors in the brain

to specifically affect endurance performance. Due to this mechanism, caffeine could modulate perceived exertion, pain, and other levels of vigor and exhaustion. Knowing caffeine could be psychologically altering, RPE rates with and without caffeine were analyzed. RPE is the Borg Rating of Perceived Exertion and a way of measuring physical activity intensity level. RPE is primarily based on how the individual feels during the exercise, through analysis of heart rate, breathing, perspiration, and muscle fatigue. The scale goes from a 6 with no exertion at all, to 20, being maximum exertion. Furthermore, by using RPE levels, a rough estimate of one's heart rate during the exercise can be estimated by multiplying the level by ten(3). Additionally,caffeine could perhaps impact endurance more greatly as in research regarding caffeine and sports performance, " caffeine crosses the membranes of nerve and muscle cells, its effects may be more neural than muscular". Studies have supported an increase in endurance performances as there is an increase in secretion of β-endorphins after caffeine consumption(4). For example, research has been done showing that in two groups of cyclists, the one which ingested caffeine had an increase in plasma β-endorphins during a two hour period of cycling as opposed to the placebo group. An increase in these endorphins is highly significant in that it leads to a decrease in pain perception, thus being a vital force in improving endurance(5). Studies have shown that caffeine improves performance in endurance versus short term activity since a majority of the energy is produced through aerobic pathways. Conversely, short-term exercise at a high intensity, is when energy is produced through anaerobic pathways. After about 3 minutes of exercise, most energy is produced through aerobic pathways, and thus, becomes classified as endurance exercise. When energy is being produced through aerobic pathways, for example, during the runs, is independent of exercise mode. Aerobic performance is most likely enhanced far more than anaerobic performance as studies have noted through increased fat oxidation and muscle glycogen sparing. Additionally, as previously mentioned by other studies, central nervous system stimulation through adenosine antagonism is also a mechanism for enhanced aerobic performance (6)(7)(8). Although studies regarding caffeine have been performed, these studies were done on adults and athletes who were professionally trained. There are few studies done on teenagers, specifically, the teenage athlete. The teenage athlete in this study trains 15 hours a week, and is physically fit than most teenagers, however, not to the level of a professional athlete. This study analyzed a teenage athlete to see if the similar benefits of a professional athlete or adult can be reciprocated in both endurance and strength fields despite being younger and not as highly trained. Additionally, few studies have been done on caffeine's impact on strength exercises. The exercises performed in this experiment vary from traditional ones, as the athlete is not running to "exhaustion" as other studies have done and the athlete is performing push-ups as a form of anaerobic activity, not lifting weights(9)(10). By running to exhaustion, it would be difficult to gauge caffeine's effect clearly as there is no clear data for comparison. By performing a "time trial", data is more effective to compare. Finally, the research done is directly comparing and contrasting both aerobic and anaerobic activity's changes after caffeine consumption which has lack of evidence. Few research has been done analyzing a single trained teenage athlete for a long period of time, twelve days in this case, and this study seeks to see if by performing this experiment for a longer duration, caffeine's effect may change. Therefore, the research done led the hypotheses to be that there perhaps could be lower RPE levels in both strength and endurance training, however, no performance advantage in strength workouts.

Results:

The effect of caffeine in performance enhancing and RPE levels for both aerobic and anaerobic exercises for the teenage athlete was examined. This was done by monitoring an athlete's performance, RPE levels, and average heart rate during one endurance exercise and another strength exercise. For the endurance portion, the athlete ran 2 miles at a 70% VO2 Max or tempo effort. For the strength portion, the athlete was to perform as many push-ups as possible in one minute. Each exercise was performed three days with caffeine and three days without caffeine, comparing results. On average, the results proved that caffeine enhanced performance and lower RPE and heart rate for the endurance portion of the test. However, caffeine had no effect on anaerobic activity. Firstly, the average heart rate over the course of the 3 days of the run with 95 mg of caffeine, or 1 cup of coffee, consumed 1 hour prior to the run was 144 bpm (Figure 1). Conversely, the average heart rate over the course of the 3 days when the run was done with no caffeine in the system was 167 bpm. With caffeine, there was a 16% decrease in heart rate, based on the averages of all 3 days(Figure 1). . However, for the strength portion, the heart rate remained the exact same on average for the three days. The average was 106 bpm(Figure 1). . This lower heart rate with

caffeine for the endurance portion also corresponds with lower RPE levels for the endurance portion. The average RPE levels for the 3 days of the run with caffeine was a 13 as opposed to the average RPE level when without caffeine was 17(Figure 1). . A 23.5% decrease in RPE levels was noted in the run with caffeine, corresponding to less exertion when caffeine was consumed(Figure 1). . Again, no change was noted in the RPE levels on the days when caffeine was in the system versus no caffeine in the system for the push-ups. In fact, on average, the RPE levels were the exact same: a level of 12(Figure 1). . Finally, performance was indeed enhanced when coffee was drunk 1 hour prior to the run, but had no effect on the push-ups. On average, the pace per mile for the 2 mile run without caffeine in the system was 6:24 per mile. However, when coffee was drunk 1 hour prior to the run, the average pace per mile for the 3 days was 6:08 per mile-- a 66.7% decrease in time(Figure 1). . On the other hand, the average number of push-ups performed without drinking coffee was 14 push-ups in one minute whereas with caffeine it was 13 on average, thus caffeine provided no benefit(Figure 1). . Therefore, caffeine enhanced performance, decreased heart, and decreased RPE levels for only endurance exercises, not strength exercises.

Analyzed Data:

Table 1

Averages of Variables	**Variables Analyzed**
144 bpm	Endurance HR with Caffeine
167 bpm	Endurance HR without Caffeine
106 bpm	Strength HR with Caffeine
106 bpm	Strength HR without Caffeine
13	Number of Push-ups performed With Caffeine
14	Number of Push-ups performed without Caffeine
6:08	PPM With Caffeine
6:24	PPM without Caffeine
12	Strength RPE Without Caffeine
12	Strength RPE With Caffeine
13	Endurance RPE Without Caffeine
17	Endurance RPE With Caffeine

Table 2

Percent Decrease	**Variables Analyzed- Aerobic Test Only**
66.7%	PPM

16%	HR
23.5%	RPE Levels

Discussion:

The twelve days in which the experiment was conducted-- three days of running with caffeine, three days of running without caffeine, three days of push-ups with caffeine, three days of push-ups without caffeine-- showed that caffeine only had a significant impact on endurance exercises, not strength exercises. This indicates drinking coffee or ingesting any type of caffeine is only of most significance to endurance athletes. These results emphasize the importance mental stamina plays in an endurance athlete more so than a strength athlete or one that participates in shorter intensity activities. Caffeine's ability to mentally recharge a person provides the most profound impact in exercises in which one must withstand pain for a longer duration of time. The hypothesis stating that caffeine would lower RPE, heart rate, and increase performance for endurance exercises was supported in the study. Additionally, the hypothesis that caffeine would not enhance performance for the strength exercises was also supported. However, the hypothesis that caffeine would however lower RPE levels and heart rate for the push-up test as well was not supported by the study. This perhaps was due to the fact that caffeine's competition with adenosine receptors is most directly associated with aerobic activity. Since the push-ups were only a minute long, the athlete did focus and energy for a long time. Additional research about caffeine's competition with adenosine receptors was then done to see why specifically RPE levels decreased only in aerobic activities, owing to the fact that there is a large mental component. The antagonism at the adenosine receptors leads to several mechanisms which are crucial in caffeine's more significant effect on aerobic exercise. Caffeine increases energy metabolism throughout the brain and activates noradrenaline neurons, affecting the local release of dopamine. This release of dopamine increases adrenalin, leading to an overall better mood and increased energy(11). Perhaps, this mechanism of releasing adrenaline to increase energy is of more significance when needing to muster through longer durations as opposed to a 1 minute duration. The increase in adrenaline created a decrease in RPE levels as the athlete felt as if they had more energy during the run. Moreover, the accuracy of using the Borg Rating of Perceived Exertion seems to be fairly accurate as based on the rating, one can multiply the levels by ten to estimate average heart rate during the period. Obviously, these are just estimations, not extremely accurate representations. However, these estimations seem to coincide with the data and rating the athlete gave themselves in this experiment. For example, the rating of 13 during the running portion with caffeine should lead to a heart rate of 130. This is not terribly far off of the average of 144 bpm. The rating of 17 given on the day of running with caffeine should lead to an estimated heart rate of 170 bpm. This is again not far off of the average of 167 bpm. Thus, the RPE is a reliable indicator of exertion levels. There are several limitations in this experiment which did occur. Firstly, this experiment analyzed one highly trained high school athlete over the course of 12 days. Perhaps if multiple athletes, such as ten or more, were analyzed there could have been a much wider and varying set of results. People might have differing responses to caffeine, especially in teens, so these results cannot be a standard for every person. Additionally, coffee was used as the source of caffeine here.Perhaps caffeine pills or other gels may have different results, but for the sake of this experiment being performed on a teenager and not an adult, coffee was resorted to for safety. Furthermore, as previous studies have only analyzed caffeine's effect for one or two days, this study analyzed caffeine for a longer period of time. However, the extent of caffeine's impact on aerobic and anaerobic activity did not lessen over the period, indicating that it can be beneficial for an avid, daily, drinker. As many studies perform studies using caffeine pills or gels, this study used a common household item-- coffee. Thus, this study proves that a common household item can have profound effects on an endurance athlete's performance. Finally, certain drinks such as soda or gatorade have caffeine in them, but these drinks may provide different results than those found in coffee. Thus, the experiment's results are consistent with data from various studies, however, they cannot be the same case for all teenage athletes.

Materials/Methods:

For the endurance portion of the experiment, the athlete used a Garmin Forerunner 35 watch to monitor heart rate, pace, and distance of runs. Additionally, the athlete also consumed 95 mg of brewed coffee with 2 tablespoons of full fat milk and 2 teaspoons of sugar exactly 1 hour prior to running. The time of running was always at the same time each day. The athlete ran at eight in the morning and coffee was consumed at seven in the morning. Similar weather conditions were also picked each day, with close humidity levels and temperatures. This way, the athlete could not feel more tired on a particular day due to higher temperatures or humidity. The athlete ran a distance of 2 miles at a tempo pace, or 70% of VO2 max. Thus, the pace should have been in the 6:15-6:25 range ideally for this particular athlete. The pace and average heart rate was recorded during the 2 mile distance. For the strength portion, each athlete again consumed 95 mg of brewed coffee with 2 tablespoons of full fat milk and 2 teaspoons of sugar exactly 1 hour prior to performing the push-ups test. The athlete turned on the watches with a timer for a minute and performed as many pushups as possible during this time period. At the conclusion, heart rate was recorded as well as how many pushups they were able to perform consecutively. Finally, at the conclusion of each session, the athlete recorded their RPE level based on the scale and how they felt based on effort during the session. The Borg Scale used ranged from 6-20.

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APPENDIX H:

EXIT TICKET

Self-reflection 1:

What did you do well during the discussion?

Were you able to achieve your goal?

What is one skill that you want to build on for the next discussion?

Self-reflection 2:

What are 2 things you learned today from your partner (s) during the discussion?
Feedback for [teacher] on the [topic/activity] ➢ *I like/don't like _____ because…* ➢ *This could be more effective if…* ➢ *What if…*

LESSON 6

Lesson: Manuscript Assessment

Timeframe: approximately 1 – 2 class period or hybrid

Target audience: Middle school – High school Sophomore

- Rigor can be increased for high school by decreasing embedded UDL strategies

Materials: IRA/NCTE Research Paper Scaffold blank template, IRA/NCTE Example Student Research Paper sample, IRA/NCTE Example Student Research Paper answer sheet

Teacher prep:

Supplement A: IRA/NCTE Research Paper Scaffold blank template

Supplement B: IRA/NCTE Example Student Research Paper sample

Lesson:

ASSESSMENT

- *Students will be provided IRA/NCTE Research Paper Scaffold blank template and IRA/NCTE Example Student Research Paper sample.*

- Students will be given a brief introduction to the objectives:
  - *Demonstrate comprehension of Manuscript process*

- *(ASSESSMENT)* Teacher will explain to students that they have to fill-out the Research Paper Scaffold utilizing the Sample Research Paper sample. The teacher can decide whether to have students continue the assessment as homework to be returned completed the next day (hybrid) or have the students continue the assessment the following day.

Supplement A:

Name: _____ Date:_____

Research Paper Scaffold

Research Question

_____
_____
_____
_____

Hook

What is interesting about this question? How do the authors grab your attention with an interesting fact that might make them curious about this topic?

_____
_____
_____
_____
_____

Literature Review

Find five articles about your topic and list the relevant facts from each one.

1. According to (*author/source*)_____(*date*) the main idea about this subject is

_____

_____

List facts from the source that support this idea

1._____
2._____
3._____
4._____
5._____

Author_____concludes_____
_____about the topic.

2. Another idea, by (*author/source*)_____(*date)*_____
is_____
_____.

1._____
2._____
3._____
4._____
5._____

Author_____concludes_____
_____about the topic.

3. A third writer, _____ (*date*) states that

_____
_____.

1._____
2._____
3._____
4._____
5._____

Author_____concludes_____

_____about the topic.

Literature Review (continued)

4. A fourth source, _____ (*date*) states that _____
_____
_____.
1._____
2._____
3._____
4._____
5._____
Author_____concludes_____
_____about the topic.

5. Yet another idea, from _____ (*date*) is that _____
_____
_____.
1._____
2._____
3._____
4._____
5._____
Author_____concludes_____
_____about the topic.

Analysis

The author found _____(how many) main idea/s about_____(main idea).

Explain how the ideas are similar or differ.

_____
_____
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_____

Original Research

In order to test the ideas about _____(main idea)
How did the author test the idea? *Describe the method that was utilized and how it was applied.*

Results: (*What happened?)*
Explain the results.

Conclusion

How did the author's data answer the author's research question?

References

List the references utilizing the following format:

Author last name, First initial. (Date). Title of article. Date retrieved (if online publication), pages (if print publication) of the references cited.

Example: Roderick, Eddie. (1974). The Effects of Excess Oxygen in Rivers. Retrieved January 8, 1974, from http://www.BostonPublicLibrary.com/rivers/oxygen.html

Supplement B:

Example Student Research Paper

Color Psychology Paper

http://www.readwritethink.org/files/resources/lesson_images/lesson1155/example_paper.pdf

Research Question:
How does color affect one's mood?

Review of Literature:
Colors may just seem simple and unimportant, but they affect our daily lives more than we may know. If someone is feeling angry, it could just be because they're angry, *or* it could be perhaps that they are surrounded by or looking at the color red. That's right! People's moods can change just because they are looking at different colors! There are many theories on how just a simple color can change one's whole mood.

According to Johnson (2007), color does affect mood by producing certain chemicals and stimulating different feelings such as hunger. For example, blue can make one feel calm because it releases calming chemicals, and red can make one hungry because it is an appetite stimulant. Yellow can make one feel irritated, and it is a fact that people lose their temper most in yellow rooms. However, pink is tranquilizing and can make one feel weak. In conclusion, Johnson says that depending on the color, one's body can do things (like producing chemicals) that cause a certain emotional reaction (mad, sad, etc.).

Another idea, by Smith (2007), is that the effect color produces is based on what one's body does in response. For example, yellow is mentally stimulating, and activates memory, whereas red increases confidence. Also, brown can make a person feel orderly and stable, while a dark blue can make one feel sad. Therefore, Smith says that different colors do in fact change one's mood and the consequences can be negative or positive.

A third writer, Wollard, (2000) seems to think that color can affect one's mood, but the effect also can depend on one's culture and what one's personal reflection may be. For example, someone from Japan may not associate red with anger, as people from the U.S. tend to do. Also, a person who likes the color brown may associate brown with happiness. However, Wollard does think that colors can make everyone feel the same, or close to the same, mood. According to Wollard, pink reduces aggression, which is why the walls of the jail cells in the Seattle prison are pink! Also, brown can make one feel comforted. Wollard feels that colors do affect one's mood, but there are other factors that can alter what one is supposed to feel.

Eric, John, and Paraag's (2007) main point about color psychology is that color has both a physiological and psychological effect. For example, green makes people feel relaxed because it relaxes their muscles and makes them breathe deeper and more slowly. Furthermore, blue lowers blood pressure, which makes one feel calm. Eric, John, and Paraag conclude that color affects one's mood because of what it does to the body.

Yet another idea, by Airey (2006), is that color is energy, and it can have a physical, mental, spiritual, and/or emotional affect on people. He states that black can make one feel sophisticated and secure, but it can also make one feel depressed. Also brown can make a person feel reliable and serious, while yellow lifts self-esteem. Therefore, Airey concludes that different colors can have different kinds of affects on people.

Analysis:

There are three ideas about color psychology in these sources, and they all say that color affects one's mood. They differ based on what factors influence the effects of color, such as culture, opinion, and what goes on inside one's body. One of the three ideas is that color affects mood based on one's personal opinions. For example, if a person dislikes the color pink, he may associate pink with hate. Another idea states that color affects mood based on one's culture. For example, someone from the U.S. may think of the color green when referring to envy, while people in Japan think of yellow in connection with wanting what someone else has. However, the majority of the sources consulted say that color affects mood by influencing what goes on inside of people. For example, seeing the color blue releases calming chemicals, which in turn makes one calm. Also, because yellow is the hardest color for the eye to focus on, people may become irritated when looking at yellow, and it is a proven fact that babies cry most in yellow nurseries. These theories do not seem to have much in common.

Methodology:

In order to test ideas about how color affects one's mood (color psychology) this researcher will test sixty middle school students (thirty girls and thirty boys) on how the colors green, blue, black, yellow, red, pink, and brown make them feel. The students will mark the feeling that each color makes them feel, according to the choices shown on the example survey below.

Example Survey

(The only thing that changes in each different survey is the color being tested and the gender of the student responding):

Choose as many answers as fit your feeling for the color. Does the color make you feel:

Mad/Angry?
Sad/Depressed/Cold?
Secure/Safe?
Irritated/Annoyed?
Calm?
Relaxed?
Fun/Excited?

Happy/Cheery?
Tired/Sleepy/Drowsy?
Bored?
Losing Energy/Weak?
Neutral/Balanced?
Love/Affection?
Dislike/Hate?

Survey Results:

Most female middle school students associated these feelings with these colors…

Black	Green	Yellow	Pink	Brown	Red	Blue
Sad/Cold/Depressing (43%)	Neutral/ Balanced (27%)	Happy/Cheery (53%)	Happy/Cheery (27%) *and* Love/Affection (27%)	Bored (40%)	Mad/Angry (30%) *and* Love/Affection (30%)	Calm (23%)

So, the greatest number of female middle school students thought that black made them feel sad, cold, and depressed; and green made most of them feel neutral and balanced, and so on. The numbers in parentheses by the feelings show the percentage of girls that felt that way. The reason most of these percentages are so low is that there were many different responses, and for most feeling categories there were only one or two girls who felt that way.

Most male middle school students associated these feelings with these colors…

Black	Green	Yellow	Pink	Brown	Red	Blue
Sad/Cold/Depressed (37%)	Secure/Safe (27%)	Happy/Cheery (17%)	Love/Affection (33%)	Bored (20%)	Mad/Angry (27%)	Relaxed (23%)

So, the greatest number of male middle school students thought that black made them feel sad, cold, and depressed; and green made most of them feel secure and safe, and so on. The numbers in parentheses by the feeling show the percentage of boys that felt that way. The reason these percentages are so low is that there were many different responses, and for most feeling categories there were only one or two boys who felt that way.

Conclusion:

Color does affect one's mood, but it can affect boys and girls differently. For example, while most female middle school students found green neutral and balancing, most male middle school students found it secure and safe. However, there are also some similarities between the female and male middle school students. For example, most female middle school students thought that brown made them feel bored, and so did the male middle school students! Also, both found that pink made them feel love and affection. However, some results in this study were different from the research cited. For example, the research stated that brown would make girls and boys feel secure and safe, but instead it made them feel bored. Furthermore, the research said that yellow would make boys and girls feel irritated, but most boys and girls reported that it made them feel happy and cheery. Overall, most of the results were different from the research sources consulted. In any case, it is obvious that colors have a great effect on one's mood.

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Lesson 7

JEI Teacher Support-Bridge Lesson

Timeframe: Beginning of Science/Research project –> Prior to JEI manuscript submission

Support resources:

- JEI will support students during their science/research project via:
  - Manuscript Organizer (Highly recommended):
    - https://www.emerginginvestigators.org/documents/experimental-design-tool
  - Literature Research Websites/Inquiry-based Lesson Resources/General Science Programming:
    - https://www.emerginginvestigators.org/resources
  - Submission Guide:
    https://www.emerginginvestigators.org/submissions/guidelines
    - Publishing with JEI
    - Manuscript Content
    - Author Eligibility
    - Writing a Scientific Manuscript
    - Preparing for Submission
    - Permissions and Licensing
  - Q & A session with JEI staff as the students are working on the respective manuscript part (methods, results, discussion and introduction).
    per appointment only if volunteer staff is available
  - Hypothesis-Driven Research:
    - https://www.emerginginvestigators.org/submissions/hypothesis-driven-research
  - Engineering-Based Projects:
    - https://www.emerginginvestigators.org/submissions/engineering-based-projects
  - JEI Peer Review Process:
    - https://www.emerginginvestigators.org/submissions/review-process
  - Additional Classroom Exercises:
    - https://www.emerginginvestigators.org/classroom_resources
  - Submission Faqs:
    - https://www.emerginginvestigators.org/submissions/faq

LESSON 8

Lesson: Peer Review

Timeframe: approximately 1 – 2 class period or hybrid

Target audience: Middle school – High school sophomore

- Rigor can be increased for high school by decreasing embedded UDL strategies

Materials: Classroom Daily Goals slip, Peer Review Rubric, Exit Ticket slips

Teacher prep:

Supplement A: Classroom Daily Norms Goals

Peer Review overview video

https://www.youtube.com/watch?v=rOCQZ7QnoN0

Describe-Evaluate-Suggest method

Methodology that allows for substantive feedback and frames the structure for constructive criticism.

https://elireview.com/2016/08/03/describe-evaluate-suggest/?_ga=2.150532146.509072995.1607193011-1313293191.1606592276

> ***Describe*** *– say what you see as a reader*
> ***Evaluate*** *– explain how the text meets or does not meet criteria established in the prompt*
> ***Suggest*** *– offer concrete advice for improvement*

Supplement B: Peer Review Rubric

Supplement C: Exit Ticket

Lesson:

PEER REVIEW

- *Students will be given a brief introduction to the objectives:*
  - Peer review and providing constructively critical comments
- (*ACCOUNTABLE TALK*) Teacher will begin class by having students record their Classroom Norm Daily Goal in their lab notebooks.
- (*INTERACTIVE LECTURE-VIDEO*) Teacher will introduce Peer Review as a method to provide both praise and constructive criticism. Remind students that Accountable Talk respectable commenting tenets should be the backdrop for all of their Peer Review constructive comments. Teacher will then show the Peer Review overview video. Students should be advised to take notes of key ideas.
- (*TURN AND TALK*) Teacher will pair students and they will discuss 5 key take-aways from the video.

- (*GROUP DISCUSSION-VIDEO*) Students will share out their insights from the video on the key parts of Peer Review. Teacher will then introduce the "*Describe-Evaluate-Suggest" method.* Teacher will show Eli Review video.

    - The teacher should write a list of exemplars of appropriate comments and underwhelming comments. Students will be paired and asked to identify which comments are appropriate and which are inappropriate/underwhelming comments.

- (*PEER REVIEW*) Teacher will pair students for sharing of manuscripts. Students will review the work of one of their classmates via Google Docs/hard copies. Teacher will then provide an overview of expectations and structure:

    - Students have to offer a minimum of ten substantive comments on their partners' documents using the comments/edit function on Google Doc or directly on the hard copy.

    - Students will utilize the *Peer Review rubric* (***Supplement*** B) to assess one another's work. Students will be provided a Peer Review rubric via Google Docs/hard copy. Teacher will state that they are not "grading" the document, but will be utilizing the categories and qualities listed on the rubric to help their structure their comments.

        - Each student should utilize an even mix of praise for what their partner is doing well and constructive criticism to help them improve.

        - Commenting superficially without explanation, (ie. "good job", "great insight"); providing only critical comments; or commenting on grammar, mechanics and spelling, will result in deducted points from the overall grade.

    - Students will finish the activity by utilizing their in-text comments, and rubric, to write a 1-2 paragraph(s) summarizing their feedback.

        - Remind students that they are engaging in a conversation about their classmate's ideas. They should NOT focus on grammar mechanics or spelling.

        - Students should focus on the positive aspects of the draft, and then provide constructive feedback and suggestions on what could be improved or changed, following the *Describe - Evaluate - Suggest* framework.

    - Students should then edit their work according to the constructive feedback/questions as a homework assignment or done in-class if time allows.

- *(PEER REVIEW 2nd Round*optional*)* Teacher will then change the pairings and students will be provided another opportunity to peer review.

        - Once students receive their reviewed work back after two rounds of peer review, they should edit their work according to the constructive feedback/questions as a homework assignment or done in-class if time allows.

- (EXIT TICKET) Teacher will provide Self-Reflection activity (Supplement C) to students.

Supplement A:

CLASSROOM NORM DAILY GOAL

- ❑ I will use a respectful **tone** and appropriate language
- ❑ I will **wait** for other people to share their ideas and will **not interrupt** them
- ❑ I will demonstrate active listening by making eye contact and using appropriate **body language**
- ❑ I will **paraphrase** what other people said to show that I understood their claims
- ❑ I will utilize **Claims**, **Reasoning** and **Evidence** when sharing my thoughts

My goal for today is to:

Supplement B:

Peer Review Rubric

Directions: Use the checklist below to guide your review of a pre-submission JEI Manuscript.

Introduction:
___ Overall topic is clearly described
___ Significance of the topic is clearly stated.
___ The objective of the study makes sense given the background
___ Hypothesis clearly stated (if applicable).
___ A brief summary of the results is provided

Methods:
___ Methods described in clear enough detail that someone unfamiliar with the study could repeat the experiment.
___ Measurements clearly explained.
___ Explanation provided for why pieces of equipment or other instruments were used.
___ Units of measure (mL, cm, etc.) used correctly.

Results:
___ Graphs properly displayed, with both axes identified.
___ Units of measure provided.
___ Results are clearly described in the text

Discussion:
___ Key results are summarized
___ Statement addressing whether data support hypothesis.
___ Further discussion of results; i.e.; why did the experiment yield these results? Were they expected? Why or why not? What might explain the results?
___ Discussion of additional experiments that might help further explore the research question.

General:
___ Paper is well-written overall.
___ Report provides new insight or perspective in the field.

Do you recommend the paper for publication?
___ Strongly recommend.
___ Recommend, with revisions.
___ Do not recommend.

Explain your recommendation:

Supplement C:

EXIT TICKET

Self-reflection 1:

What did you do well during the discussion?

Were you able to achieve your goal?

What is one skill that you want to build on for the next discussion?

Self-reflection 2:

What are 2 things you learned today from your partner (s) during the discussion?
Feedback for [teacher] on the [topic/activity] ➢ *I like/don't like _____ because…* ➢ *This could be more effective if…* ➢ *What if…*

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